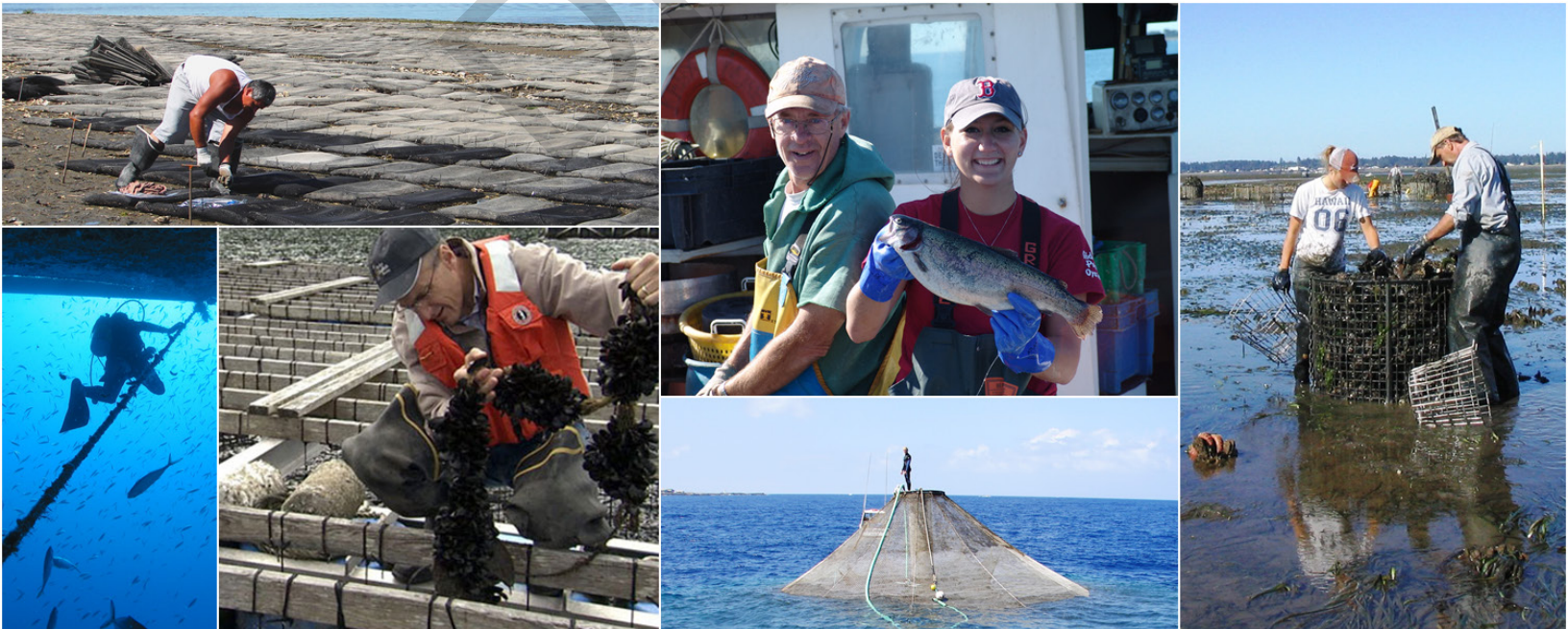




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Marine Aquaculture Strategic Plan

FY 2016-2020



Marine Aquaculture Strategic Plan

FY 2016-2020

U.S. DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Office of Aquaculture



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Contents

Letter from the Director	iii
Setting the Stage: Opportunities and Challenges	2
Vision and Mission	6
Evaluating Our Impact	7
Goal 1: Regulatory Efficiency	8
Goal 2: Tools for Management	10
Goal 3: Technology Development and Transfer	12
Goal 4: Informed Public	14
Cross-Cutting Strategies	16
Deliverables	17
Appendix 1 - Program Overview	A1
Appendix 2 - NOAA Aquaculture Funding History	A4

Letter from the Director

Dear Partners:

Limits to wild fisheries, environmental changes, the nutritional benefits of seafood, and trends in global seafood markets underscore the need to develop U.S. marine aquaculture. U.S. marine aquaculture enhances coastal resiliency, creates jobs, improves food security and human nutrition, and is a tool for restoration of species and habitats.

We have made significant progress in achieving our aquaculture mission since the adoption of our last strategic plan, the 2007 NOAA 10-Year Plan for Marine Aquaculture. The federal regulatory process for aquaculture has been improved, key products that serve the scientific needs of management and industry have been developed, and aquaculture is now listed as a NOAA priority. These efforts helped spark the recent growth of the U.S. marine aquaculture production, which now averages 8% per year.

In this 5-year Strategic Plan (Plan), we take a fresh look at our priorities and address the regulatory, scientific, technical, communications, and organizational needs to advance U.S. marine aquaculture. This Plan will help ensure that NOAA is focused on critical aquaculture priorities to ensure an efficient and strategic use of limited resources.

This Plan is intended primarily to guide aquaculture activities within NOAA Fisheries, but incorporates key activities undertaken by our partners at the National Ocean Service (NOS) and the Office of Oceanic and Atmospheric Research (OAR). While cognizant of limited resources, some of this Plan is aspirational to drive results and help us reach our full potential. The Plan captures the program's highest priorities and does not include everything the Office will accomplish over this time period.

This Plan was developed over several months through a collaborative process and included input from the entire NOAA aquaculture team. In creating this Plan, the Office sought review and input from other NOAA Fisheries Offices, [the Marine Fisheries Advisory Committee (MAFAC) Aquaculture Task Force and the public.]

It took teamwork and advice from [stakeholders, scientists, producers, nongovernment organizations, and government agencies] to produce this Plan and it will take the same to fulfill the challenging mission that we have laid out. By working together we can ensure that U.S. marine aquaculture grows to provide significant environmental, social, and economic benefits to the American public.

Thank you,

Dr. Michael Rubino
Director
Office of Aquaculture

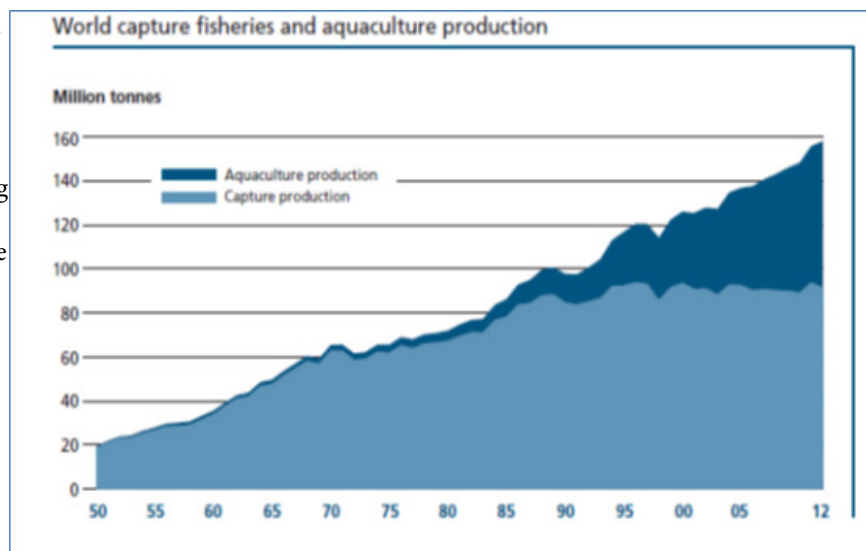
Setting the Stage: Opportunities and Challenges

Aquaculture in a global context

Global population is rising, but the global abundance of wild fish is not. Wild fish harvests have been flat for the last 30 years. Seafood plays an important role in global food supply and security. About 1 billion people rely on seafood as their primary source of protein worldwide. Ensuring that seafood supply can keep up with increased demand from population growth and shifting demographics is vitally important. Seafood contains nutrients essential for human health. The U.S. federal nutrition guidelines¹ affirm that Americans should increase their seafood consumption from the current level of one meal a week to two meals a week.

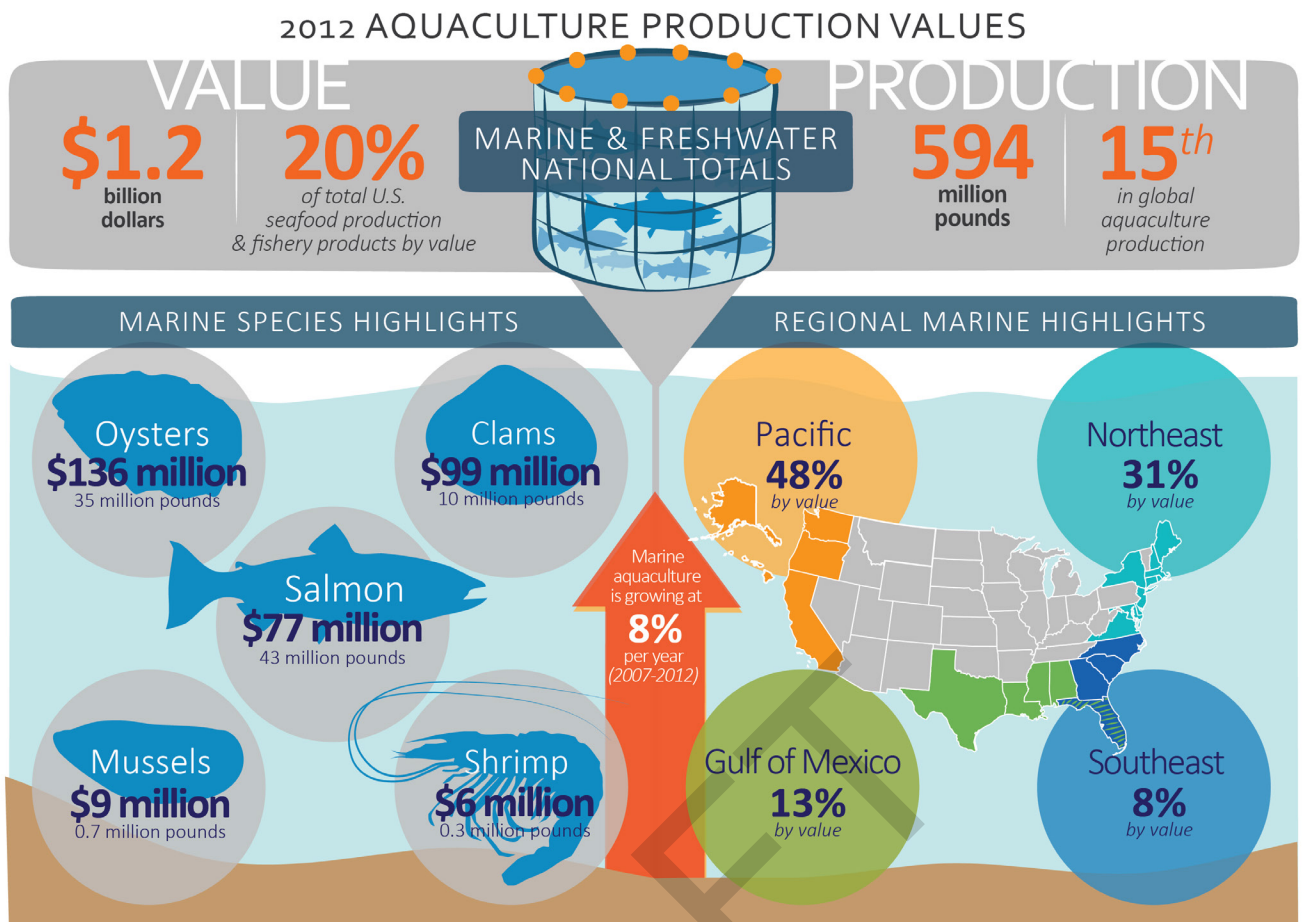
According to the United Nations Food and Agriculture Organization (FAO), “with capture fisheries production stagnating, major increases in fish food production are forecast to come from aquaculture. Taking into account the population forecast, an additional 27 million metric tons of production will be needed to maintain the present level of per capita consumption in 2030.” The FAO estimates that, globally, 28% of stocks are fished at biologically unsustainable levels. Some great efforts have been made to address the overfishing problem, and incremental progress has been made at a global scale. But even with such improvements, wild capture fisheries will not meet the demand for seafood.

Aquaculture is well placed to help fulfill the demand. In many parts of the world, aquaculture has already helped improve nutrition and food security. Aquaculture production reached an all-time high of 90 million metric tons in 2012 and is the fastest growing form of food production at 6% per year globally, outstripping the population growth rate.²



¹ U.S. Department of Agriculture's Dietary Guidelines for Americans, 2011.

² Food and Agriculture Organization of the United Nations. "The State of World Fisheries and Aquaculture: Opportunities and Challenges." Rome, 2014.



The importance of marine aquaculture in the United States:

NOAA Fisheries and its partners have made great progress in ending overfishing through sound, science-based management practices, while ensuring seafood production and maintaining economic opportunities. However, the seafood produced from domestic wild capture fisheries is only a small portion of the seafood that is actually consumed in the United States. The United States is one of the largest markets for seafood in the world. The United States imports a greater percentage of seafood, approximately 90%, than any other nation despite possessing the world's largest Exclusive Economic Zone. With a rising seafood trade deficit of over \$12 billion, this reliance on imports moves potential seafood jobs overseas and poses a risk to our nation's food security.

The United States produces relatively little seafood from aquaculture, producing \$1.2 billion of aquaculture seafood in 2012. Domestic aquaculture only makes up 6% of total U.S. seafood production by volume and 20% by value. While the United States has done a good job at managing its wild stocks, the full potential for aquaculture has yet to be realized and U.S. interests are missing out on significant business and trade opportunities.

While a small industry compared with potential, U.S. marine aquaculture is an economically important sector regionally. In many fishing and coastal communities, aquaculture creates significant jobs and supports other sectors such as seafood processing, feed and equipment manufacturing, and food service. While total U.S. aquaculture production (freshwater and marine) has declined in recent years, U.S. marine aquaculture production has been increasing at a rate of 8% a year on average for the last 5 years.³ In the Northeast (Maine through Virginia), the landed value of aquaculture products was \$219 million in 2013 – the third largest value of any seafood category landed in the region, eclipsed only by scallops and lobsters. For comparison, all ground fish landings in the Northeast combined were valued at only \$61 million. Much of the growth in aquaculture in the Northeast comes from oyster farms in Virginia and salmon farms in Maine. Many other states, including

³ Fisheries of the United States 2013. Current Fishery Statistics No. 2013. September 2014. National Marine Fisheries Service Office of Science and Technology.



Massachusetts, Rhode Island, Maryland, and Virginia, are reporting all-time highs in shellfish aquaculture production. On the West Coast, aquaculture continues to make strong contributions to the coastal economy. For example, the aquaculture industry in the State of Washington includes over 100 marine farms, stretching over 15,000 acres and producing over \$200 million worth of seafood annually.⁴

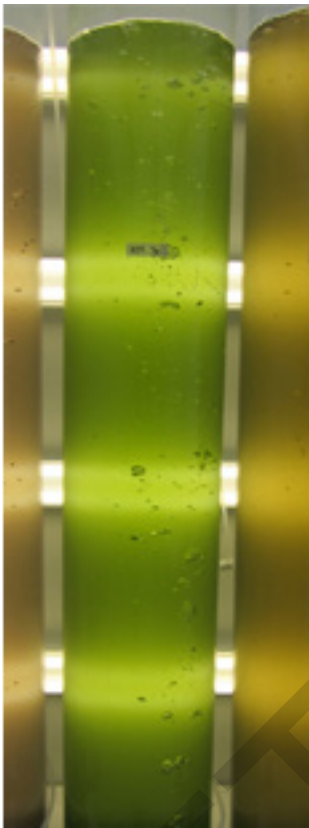
In addition to opportunities to expand aquaculture in coastal waters, emerging options include growing seafood further offshore and onshore in tanks. NOAA Fisheries has been involved in regulatory, science, and technology development for both options. A recent study by the Food and Agriculture Organization of the United Nations (FAO)⁵ concluded that the United States is the country with the greatest potential for offshore aquaculture. In 2014, federal agencies issued the first permits for mussel aquaculture in federal waters in New England and California using submerged longlines. Several new permit applications have been received by federal agencies for aquaculture projects in federal waters off California. Federal waters may be programmatically open to commercial-scale finfish farming in the Gulf of Mexico once the regulation to implement the Gulf of Mexico Fishery Management Plan for Offshore Aquaculture is finalized.

The benefits of aquaculture are not limited to those associated with growing seafood. Aquaculture can be a tool to help recover endangered species when recommended in an approved recovery plan or when determined to be necessary to prevent extinction of a species. Aquaculture is an important factor in preventing the extinction of several species that NOAA Fisheries has identified as being at high risk of extinction, including endangered abalone, some Pacific salmon species, and Atlantic salmon. Aquaculture is also an important tool for habitat restoration and for stock enhancement of commercially and recreationally important species. Shellfish hatcheries are currently being used for oyster restoration efforts in the Chesapeake Bay, Puget Sound, and elsewhere. Salmon hatcheries are used to enhance the productivity of commercial and recreational fisheries on the West Coast.

While the U.S. marine aquaculture industry has grown in recent years, much more is required if the United States is to achieve its potential as a significant aquaculture-producing nation. This Plan will guide NOAA Fisheries actions and set the stage for a new era of domestic seafood production through environmentally responsible aquaculture.

⁴ 2012 Census of Agriculture: Census of Aquaculture 2013. Volume 3. Special Studies Part 2. September 2014. United States Department of Agriculture, National Agricultural Statistics Service.

⁵ Kapetsky, J., J. Aguilar-Majarrez, and J. Jenness. 2013. "A global assessment of offshore mariculture potential from a spatial perspective." FAO Fisheries and Technical Paper. No. 549. Rome, FAO. 181 pp.



Vision and Mission

Vision: A robust U.S. marine aquaculture sector that creates jobs, provides sustainable seafood, and supports healthy oceans

Mission: To provide science, services, and policies to support significant growth of responsible U.S. marine aquaculture

Our marine aquaculture vision and mission advance NOAA's broader mission and vision, as well as NOAA Fisheries' priorities. Marine aquaculture development is a critical part of the agency's strategy for economic and environmental resiliency in coastal communities. Marine aquaculture operations provide a year-round source of high quality jobs and economic opportunities in coastal communities that may have limited opportunities besides tourism and commercial fishing. Marine aquaculture is also a resource-efficient method of increasing and diversifying U.S. seafood production that can help augment and stabilize U.S. seafood supply in the face of environmental change and economic uncertainty. Certain forms of marine aquaculture production, such as shellfish and seaweed aquaculture, also provide environmental benefits by removing excess nutrients from our waterways.

NOAA's Vision:

Resilient Ecosystems, Communities, and Economies

NOAA's Mission:

Science, Service, and Stewardship

NOAA Fisheries' Priorities:

Ensure the productivity and sustainability of fisheries (including aquaculture) and fishing communities through science based decision-making and compliance with regulations.

Recover and conserve protected resources through the use of sound natural and social sciences.

Evaluating Our Impact

At least a 50% increase in responsible U.S. marine aquaculture production by the year 2020.

U.S. marine aquaculture production has increased 8% annually over the past 5 years of available data. NOAA's actions have made a positive contribution to this increase, and if we implement this Plan effectively, we can expect to have a positive impact on the future growth of the marine aquaculture sector. To drive our activities and evaluate our impact, we have established the above target that aims for a continuation of the annual 8% growth trend in production over the next five years.¹ To achieve our target in an environmentally responsible manner, we will focus efforts on four broad goals: regulatory efficiency, science-based tools for management, technology development and transfer, and an informed public. Within each goal, we have identified several objectives and the strategies we will use to achieve them. We also have identified several cross-cutting strategies that apply to many of the goals and objectives developed in this Plan that are critical to achieving our aquaculture mission.

¹ Progress will be measured based on data available in Fisheries of the United States 2016 and 2020 editions



Goal 1: Regulatory Efficiency

Develop coordinated, consistent, and efficient regulatory processes for the marine aquaculture sector

The regulation of U.S. commercial marine aquaculture is complex, involving multiple agencies, laws, regulations, and jurisdictions. As a result, permitting processes can be time-consuming and difficult to navigate, significantly limiting access to sites.

We will work collaboratively to increase regulatory efficiency in both state and federal waters. Success will depend upon collaboration with other NOAA programs, federal agencies,¹ state and local agencies, and tribal groups. Each of these partners plays a substantial role in the regulation of commercial marine aquaculture.²

In addition to specific regulatory responsibilities, NOAA Fisheries (through the Department of Commerce) has a broad charge “to provide for the development of aquaculture in the United States.”³ As one means of achieving this charge, NOAA Fisheries plays a critical role as a convener, coordinator, and science provider to help facilitate permitting and regulatory processes in marine waters nationwide.

NOAA's Dual Regulatory Roles in Marine Aquaculture

In federal waters, typically 3-200 nautical miles from shore, NOAA Fisheries is taking on new and direct permitting responsibilities under federal fisheries management law. As regional fishery management councils develop aquaculture Fishery Management Plans (FMPs), NOAA Fisheries will develop implementing regulations, issue permits, and conduct the necessary consultations to ensure essential fish habitats and protected species are adequately protected.

In state waters and in federal waters where no applicable FMP is in place, NOAA Fisheries' role is still important. While NOAA Fisheries does not issue permits in such cases, the Agency consults with partner permitting agencies (e.g. the Army Corps of Engineers, Environmental Protection Agency) on habitat and protected species matters.

¹ Federal coordination efforts are implemented at the national-level through the Interagency Working Group on Aquaculture, which operates under the Life Sciences Subcommittee of the Committee on Science of the National Science and Technology Council.

² NOAA Fisheries works closely with other federal partners on marine aquaculture permitting, including the U.S. Army Corps of Engineers, the Environmental Protection Agency, the Food and Drug Administration, and USDA. We also work with state, local, and/or tribal agencies that have additional regulatory requirements in coastal waters. For detailed information on aquaculture permitting, visit the NOAA Fisheries Aquaculture website at: http://www.nmfs.noaa.gov/aquaculture/policy/24_regulating_aquaculture.html

³ National Aquaculture Act of 1980.

Goal 1: Regulatory Efficiency

Objectives	Strategies
Improve existing permitting processes for marine aquaculture in state and federal waters	Respond to barriers identified by stakeholders and work with permitting agencies and Congress towards regulatory and legal solutions
	Improve inter-agency coordination on aquaculture permit applications: <ul style="list-style-type: none"> Identify and consolidate redundant processes Clarify agency roles and responsibilities Build consensus on regulatory and permitting decisions
	Encourage greater use of general permits, regional or bay-wide approaches, and programmatic documents
	Work with permitting agencies to develop user-friendly and service-oriented permit application processes for permit applicants: <ul style="list-style-type: none"> Encourage the practice of pre-consultation meetings Provide easily accessible and up-to-date information to prospective applicants, including guidance documents and relevant science information Consult with and assist permit applicants as they prepare application
	Work with states and regional partners to develop additional state or regional shellfish initiatives, and support and strengthen existing initiatives
	Work to ensure that NOAA's consultation role under the Magnuson-Stevens Fishery Conservation and Management Act (MSA) and the Endangered Species Act (ESA) is efficient by working to improve understanding of processes by federal, state, and local government agencies and industry
Develop an effective framework for aquaculture in federal waters	Engage regional Fishery Management Councils on opportunities and options for aquaculture development, and implement actions taken by Fishery Management Councils
	Develop as appropriate regional environmental reviews (e.g., National Environmental Policy Act documents) for various culture methods and/or gear types to streamline review of individual permits
	Maintain or develop inter-agency offshore aquaculture working groups in regions where offshore aquaculture is underway or being proposed
Apply robust science to regulatory and management processes	Identify information and science gaps that delay permitting decisions and develop strategies to address them (e.g., internal NOAA research, grants to external partners, international collaborations)
	Translate, provide, and encourage the use of best available scientific information for use in permitting processes

Implementing many of these strategies will depend heavily on collaboration with our partners, particularly federal, state, local and tribal permitting agencies

Goal 2: Tools for Management

Encourage environmentally responsible marine aquaculture using best available science

NOAA requires scientific information to foster aquaculture development and ensure healthy, productive, and resilient coastal and ocean ecosystems.

Department of Commerce and NOAA Aquaculture Policies, and other mandates, seek to advance scientific understanding of the potential environmental effects of marine aquaculture (negative and positive) and encourage aquaculture development while avoiding and/or mitigating negative impacts.

To apply scientific knowledge to management and permitting actions, NOAA Fisheries will continue to develop science-based “tools for rules”¹ to ensure sound management, regulatory, and permit decisions. Efforts include refining and developing planning, siting, monitoring, and evaluation methods and technologies related to commercial operations.²

We will also gather scientific information on the use of aquaculture as a tool for protected species recovery, habitat restoration, and stock enhancement of commercially and recreationally important species.

In addition, regulatory and management staff within NOAA and other partner agencies require information about the effect of environmental parameters and changing ocean conditions on commercial and restoration aquaculture. Examples include ocean acidification, effect of temperature changes on pathogen transmission, ecosystem carrying capacity, habitat interactions, and the use of aquaculture as a tool for research about wild fish stocks.

Coordinating Aquaculture Science

In 2014, The White House Office of Science and Technology Policy released a National Strategic Plan for Federal Aquaculture Research (Federal Plan). The Federal Plan directs partner agencies, including NOAA, to improve coordination and implement nine strategic research priorities. As a first step, NOAA Fisheries will inventory and assess its aquaculture science program through a rigorous peer-reviewed process. This “Aquaculture Science Review” will be finalized in 2016. Objectives for Goals 2 and 3 are identical to the research priorities outlined in the Federal Plan. Strategies have been partially adapted for NOAA’s role in fulfilling the Federal Plan.



¹ “Rules” include a range of management actions including regulations, policies, and protocols for permitting decisions.

² NOS’ National Centers for Coastal Ocean Science (NCCOS) is a key partner and leads several of these activities.



Goal 2: Tools for Management

Objectives	Strategies
Advance the understanding of the interactions of aquaculture and the environment	Develop and refine siting tools and ecological forecasting models to inform aquaculture siting and management decisions
	Develop best management practices to reduce potential negative environmental effects
	Develop strategies to assess the impacts of environmental change on marine aquaculture, as well as aquaculture's role in mitigating environmental change
	Increase the understanding of ecosystem services provided by commercial aquaculture and stock enhancement
	Develop and understand the effects of aquaculture as a tool for recovering protected species, restoring habitats, stock enhancement of commercially and recreationally important species, and improving stock assessments
	Create an "Aquaculture Tool Kit" for coastal managers
Employ genetics to protect natural populations	Develop, test, and apply genetic risk models to aid in regulation and management of commercial aquaculture and stock enhancement
	Develop techniques to reduce the risks of undesired genetic impacts on wild populations
Counter disease in aquatic organisms and improve biosecurity	Develop and refine aquatic animal health risk modeling and monitoring tools to aid regulation of commercial aquaculture and stock enhancement
	Develop methods of reducing pathogen transmission and impacts
	Conduct research on the effect of changing ocean conditions (including acidification) on aquatic animal health
Increase supply of nutritious, safe, high-quality seafood and aquatic products	Provide information and collaborate to conduct research on human health effects of seafood and aquaculture (i.e., Vibrios, Omega 3s)
	Conduct research on seafood supply and food security
	Work with international partners to leverage resources and acquire information to advance "Tools for Management" objectives

Implementing many of these strategies will depend heavily on collaborating with our partners, particularly NOAA partners at the NOS NCCOS and the OAR National Sea Grant College Program, as well as external partners including federal, state, local, and tribal agencies, the aquaculture sector, academic institutions, environmental NGOs, and international partners.

Goal 3: Technology Development and Transfer

Develop technologies and provide extension services for the marine aquaculture sector

Compared to other forms of agriculture, marine aquaculture is new and dynamic. Aquaculture innovation based on robust science and technology development is one of the strongest drivers for continuous industry improvement to adapt to new opportunities and changing environmental conditions. Examples of industry needs include refining culture methods for existing aquaculture species; bringing new species “online”; developing ways to address ocean acidification; developing new feeds, vaccines, and vaccine delivery systems; developing new engineering solutions such as moorings and automation systems for offshore waters and for recirculating aquaculture systems; and developing or refining methods for species and habitat enhancement and restoration.

Goal 3 applies to NOAA’s efforts to support marine aquaculture through technology development and transfer for commercial purposes and restoration. Much of NOAA’s in-house research activities are directed at supporting management needs (see Goal 2). NOAA also conducts research to support technology development and provide science services in support of industry needs and the broader aquaculture community, frequently in partnership with researchers at universities, industry, non-governmental organizations, states, and tribal groups to leverage resources, expertise, and capabilities.

NOAA grant programs that support U.S. marine aquaculture include: the National Sea Grant College Program (Sea Grant), the Saltonstall-Kennedy Grant Program, and the Small Business Innovation Research (SBIR) program. These programs leverage NOAA resources through partnerships with external researchers and institutions. In addition, NOAA engages in private sector and public collaborations on aquaculture technology development through Cooperative Research and Development Agreements and patenting and licensing technologies.

Marine aquaculture technology and methods must be transferred to industry partners, coastal communities, and coastal managers to be effective. Sea Grant extension agents serve a critical role in this step. This model – in-house research, grants to partners, and extension services – has been applied with great success to U.S. terrestrial agriculture via the U.S. Department of Agriculture. The systems in place for marine aquaculture are not as extensive as those for terrestrial farmers, but still provide valuable services and create jobs in coastal communities.

The objectives and strategies below apply to in-house research at NOAA Fisheries Science Centers, sometimes in collaboration with various partners (e.g., international, industry, and academic researchers), as well as research by external partners funded by Sea Grant and NOAA Fisheries grants.



Goal 3: Technology Development and Transfer

Objectives	Strategies
Improve production efficiency and well-being	Advance understanding of the physiology of marine organisms in aquaculture settings to improve commercial aquaculture production and inform population and ecosystem modeling for wild stocks. Develop and refine hatchery methods for marine organisms of strategic interest
Employ genetics to increase productivity	Develop and implement selective breeding programs that maximize production efficiency and environmental compatibility of aquaculture e
Counter disease in aquatic organisms and improve biosecurity	Develop effective disease treatments for aquatic organisms
Improve performance of production systems	Develop and use tools to measure and increase efficiency of marine aquaculture systems. Engineer improved aquaculture systems for all stages of the aquaculture production cycle
Improve nutrition and develop feeds	Increase the availability of complete feeds for aquaculture species, with reduced reliance on marine fish meal and fish oil from directed fisheries Develop specialized feeds that maintain or improve the nutritional value of fish and shellfish to human health and well-being Increase the number and types of ingredients available to feed manufacturers Increase the number of species with defined nutritional requirements to optimize the development of new species-specific commercial diets Expand research on the effects of probiotics on shellfish survivability and growth
Create a skilled workforce and enhance technology transfer	Align grant programs that support educational programs and job training Support extension services through National Sea Grant Extension competitions and other methods
Develop and use socioeconomic and business research to advance domestic aquaculture	Work with partner federal and state agencies and industry to improve data collection methods and the quality of annual national aquaculture production statistics Conduct economic and job impact analyses on marine aquaculture Provide socio-economic information to support industry development Provide socio-economic information to support industry development, including research on U.S. seafood demand, local and regional markets, and the interaction of U.S. marine aquaculture with international markets and capture fisheries

Implementing many of these strategies will depend heavily on collaborating with our partners, particularly NOAA partners at the OAR National Sea Grant College Program, as well as external partners, including the aquaculture sector; national and state elected officials; federal, state, local, and tribal agencies; academic institutions; and environmental NGOs; and international partners

Goal 4: Informed Public

Improve public understanding of marine aquaculture

Integral to NOAA's aquaculture mission is advancing public understanding of marine aquaculture practices, the associated environmental, social, and economic challenges and benefits, the health benefits of eating seafood, and the science, services, and policies NOAA has to offer in support of aquaculture. Recent scientific journal articles show that marine aquaculture can be a resource-efficient, environmentally responsible form of food production that can play a significant role in increasing seafood supply, improving human nutrition, and creating jobs. However, most of the public still has limited understanding of aquaculture and may encounter information that can be out of date, inaccurate, or incomplete.

Outreach efforts will provide the public with accurate information about the state of marine aquaculture research and management and key initiatives by NOAA and its partners. Success in cultivating public understanding and support for marine aquaculture will rely upon enhancing NOAA's national and regional capabilities to support communications and outreach and building external partnerships to promote aquaculture outreach and communication.



Goal 4: Informed Public

Objectives	Strategies
Provide accessible, relevant, and up-to-date information on marine aquaculture to the public	Maintain and enhance usability of agency websites and social media, particularly for science information, permitting information, and grant opportunities
	Develop infographics, fact sheets, and communications tools to communicate scientific and regulatory information to the general public and targeted audiences
	Present information at conferences and meetings of strategic interest
	Develop educational information for a range of academic institutions and audiences
	Translate aquaculture information for varied audiences, including non-scientists and those unfamiliar with technical aquaculture information
Build support for and knowledge of marine aquaculture	Develop and implement a communications strategy to build support for and knowledge of aquaculture by: Aquaculture sector National and state elected officials Federal, state, local, and tribal agencies Seafood and Related industry News media and journalists Environmental NGOs and Foundations Commercial and recreational fishing organizations Other stakeholders such as chefs, doctors and nutritionists
Enhance NOAA's national and regional capabilities to support communications and outreach	Increase awareness of aquaculture activities within Commerce, NOAA, NOAA Fisheries, and NOAA Fisheries Regional Offices and Science Centers
	Increase inclusion of marine aquaculture in NOAA Fisheries communications and outreach activities
	Develop a coordinated approach to communications among the Office of Aquaculture, Regional Coordinators, and communications teams in regions.
	Develop a coordinated communication system among NOAA Fisheries, NOS, and OAR for aquaculture
Build partnerships to increase outreach and education capacity	Partner with educational organizations such as Sea Grant universities, aquariums, and culinary schools to disseminate knowledge and increase understanding of marine aquaculture
	Partner with other governmental agencies, industry groups, and non-profits to leverage support and collaboration on marine aquaculture issues
	Develop consistent messaging on aquaculture science and management with international partners, as appropriate

Implementing many of these strategies will depend heavily on collaborating with our NOAA Partners including NOS NCCOS and the OAR National Sea Grant College Program, as well as external partners including the aquaculture sector, national and state elected officials; Federal, state, local, and tribal agencies; seafood and related industry; news media and journalists; environmental NGOs and foundations; commercial and recreational fishing organizations; and other stakeholders such as chefs, doctors, and nutritionists.

Cross-Cutting Strategies

We have identified several strategies that apply to many of the goals and objectives developed in this Plan that are critical to achieving our aquaculture mission:

Strengthen partnerships: Our efforts to advance U.S. marine aquaculture are limited by available resources. Fulfilling nearly all of the goals and objectives presented in this Plan will depend heavily on our ability to work effectively with our partners. We must not only build upon existing partnerships, but develop new ones with key organizations to leverage resources in pursuit of common goals.

Improve external communications: Effective external communication is foundational to achieving the goals and objectives developed in this Plan. We must continue to conduct an interactive dialogue and take a “no surprises” approach when communicating with our stakeholders. We will ensure that our stakeholders receive the best service possible by being responsive, transparent, and efficient in everything we do. To do so, we must work to improve internal communications within our agency to ensure clear and consistent external communications regarding marine aquaculture.

Build internal support for marine aquaculture: Many parts of NOAA play a role in the regulation, science, and provision of services for marine aquaculture. Functioning effectively will require that NOAA personnel both within and outside of the NOAA Aquaculture Program are knowledgeable about aquaculture science and management and are committed to implementing our aquaculture mission. Building internal support for aquaculture will take commitment and leadership from Aquaculture Program staff to educate, improve communications, and build relationships throughout NOAA.

Sound program management: We must excel at the basics by executing this Plan with discipline, consistency, and accountability. We must work to ensure that resources and staff are aligned to the priorities identified in this Plan. We also must routinely evaluate our science and management programs to assess our results and ensure we are making progress in implementing this Plan.

Deliverables

The table below displays selected deliverables and actions for the Aquaculture Program for the FY 2016-2020 time period. A comprehensive list of program activities will be developed annually in an Aquaculture Annual Operating Plan.

Organization	Deliverables	FY 16	FY 17	FY 18	FY 19	FY 20
Headquarters	Finalize a Memorandum of Understanding among federal agencies for aquaculture permitting in federal waters of the Gulf of Mexico (Goal 1)	✓				
	Complete Aquaculture Science Review and develop and implement Aquaculture Science Strategic Plan (Goals 2, 3)	✓	✓			
	Expand external funding opportunities for aquaculture including Saltonstall-Kennedy, SBIR, Sea Grant competitions and public-private partnerships (Goals 2, 3)	✓	✓	✓	✓	✓
	Improve aquaculture online resources particularly science webpages (Goals 1, 2, 3, 4)	✓	✓			
	Complete an economic impact analysis for marine aquaculture and improve the accuracy of annual aquaculture production statistics (Goal 3)	✓	✓	✓	✓	✓
All Regions	Assist with grants management, including Saltonstall-Kennedy (Goal 2, 3)	✓	✓	✓	✓	✓
	Collaborate with Protected Resources and Habitat Conservation programs to complete Endangered Species Act/Essential Fish Habitat consultations on Army Corps of Engineers permits, as appropriate (Goal 1)	✓	✓	✓	✓	✓
	Improve reporting of regional aquaculture production statistics (Goal 3)	✓	✓	✓	✓	✓
Greater Atlantic Regional Office	Work with state and federal partners to identify and implement ways to improve the permit processes for aquaculture, particularly for shellfish aquaculture (Goal 1)	✓	✓	✓	✓	✓
	Conduct a review of mussel aquaculture and protected resource interactions (Goal 1)	✓	✓			
Southeast Regional Office	In coordination with federal agencies, develop a regional permit review process and issue the first permits for aquaculture in federal waters of the Gulf of Mexico (Goal 1)	✓	✓			
	Support the development of off-bottom shellfish aquaculture in the Gulf of Mexico (Goals 1, 3)	✓	✓	✓	✓	✓
West Coast Regional Office	Complete NOAA actions identified under the Washington, California, and Oregon Shellfish Initiatives (Goals 1, 2, 3, 4)	✓	✓	✓		
	Work with state agencies and local governments in Washington to improve aquaculture guidance for updates of Shoreline Master Programs (Goal 1)	✓	✓			
	Work with state and federal partners to ensure timely and efficient permitting decisions for proposed offshore aquaculture projects in the region (Goal 1)	✓	✓	✓	✓	✓

Organization	Deliverables	FY 16	FY 17	FY 18	FY 19	FY 20
Pacific Islands Regional Office	Provide regulatory guidance through the Offshore Aquaculture working group (Goal 1)	✓	✓	✓	✓	✓
	Support aquaculture amendments for the Western Pacific Fishery Management Council and develop capability to issue permits for commercial-scale aquaculture in federal waters (Goal 1)	✓	✓	✓		
	Support the issuance of programmatic permits for restoration of Hawaiian fish ponds (Goal 1)	✓	✓	✓	✓	✓
Alaska Regional Office	Coordinate with partners to support Alaska shellfish initiative (Goals 1, 2, 3, 4)	✓	✓	✓	✓	✓
Northeast Fisheries Science Center*	Provide technical assistance to industry for shellfish hatchery methods and micro-algae culture (Goal 3)	✓	✓	✓	✓	✓
	Conduct research on the ecosystem services of aquaculture and the response of shellfish to changing environmental conditions (Goals 2, 3)	✓	✓	✓	✓	✓
Southeast Fisheries Science Center*	Support the Southeast Regional Office in assessing the environmental effects of prospective aquaculture in federal waters of the Gulf of Mexico in Collaboration with the NWFSC and NCCOS (Goal 2)	✓	✓	✓	✓	✓
Northwest Fisheries Science Center*	Work with partners to advance production methods (i.e., larval rearing technology, genetics, and genomics) for key species including sablefish, Olympia oysters, salmon, seaweed, and abalone (Goals 2, 3)	✓	✓	✓	✓	✓
	Operationalize and apply the OMEGA (genetic impacts) model to additional species/stocks (e.g., red drum) (Goal 2)	✓	✓	✓	✓	
	Complete research products on the environmental effects and ecosystem services of shellfish aquaculture (Goals 2, 3)	✓	✓	✓	✓	✓
	Develop “tools for rules” for disease modeling (Goals 2, 3)		✓	✓	✓	
Southwest Fisheries Science Center*	Provide scientific support to assess the environmental effects of aquaculture in federal waters off California (Goal 2, 3)	✓	✓	✓	✓	✓
	Advance production methods (i.e., larval rearing technology, genetics, and genomics) for key species including yellowtail, white seabass and endangered abalone (Goals 2, 3)	✓	✓	✓	✓	✓
	Expand captive breeding programs and outplanting for endangered abalone, consistent with NOAA Fisheries policy and recovery plans (Goal 2)	✓	✓	✓	✓	✓
Pacific Islands Fisheries Science Center*	Provide science support to assess the environmental effects of aquaculture in federal waters off Hawaii (Goal 2, 3)		✓	✓	✓	✓
Alaska Fisheries Science Center*	Develop husbandry techniques to raise king crab to enhance wild populations	✓	✓	✓	✓	✓
	Use aquaculture as a tool to investigate the effects of climate change on wild king salmon life history and genetics.	✓	✓	✓	✓	✓
OAR National Sea Grant College Program**	Effectively manage aquaculture grant competitions for aquaculture development and extension and coordinate work of aquaculture extension agents (Goal 3)	✓	✓	✓	✓	✓
NOS National Centers for Coastal Ocean Science (NCCOS)**	Develop tools for coastal managers, including ecological assessments and forecasts, spatial planning tools, climate change assessments, and innovative technologies (Goals 1, 2, 3, 4)	✓	✓	✓	✓	✓

* Additional aquaculture science deliverables, including those addressing emerging science needs, will be identified through the NOAA Aquaculture Science Review in 2016.

** The National Sea Grant College Program and NOS NCCOS are in the process of developing aquaculture strategic plans specific to their organizations.

Appendix 1 - Program Overview

1. Legal, Regulatory, and Policy Drivers

The primary laws driving NOAA's Aquaculture Program are the National Aquaculture Act of 1980, the Magnuson-Stevens Fishery Conservation and Management Act (MSA), and the Fish and Wildlife Coordination Act. Aquaculture activities are also subject to provisions of other laws under NOAA's purview, including the National Environmental Policy Act (NEPA), Marine Mammal Protection Act (MMPA), Endangered Species Act (ESA), the Essential Fish Habitat (EFH) provisions of the MSA, and other legislation. NOAA's aquaculture activities are also guided by the NOAA and Department of Commerce Aquaculture Policies of 2011, the National Strategic Plan for Federal Aquaculture Research (2014), directives in the National Ocean Policy Implementation Plan (2013), and annual NMFS Priorities Statements.

2. Institutional Structure, Resources, and Key Activities

NOAA's aquaculture activities, collectively known informally as the NOAA Aquaculture Program, are conducted in three NOAA line offices: NOAA Fisheries (NMFS), the Office of Oceanic & Atmospheric Research (OAR), and the National Ocean Service (NOS) - each with distinct and complementary roles.

NOAA coordinates interagency activities through the Interagency Working Group on Aquaculture (IWG-A), which includes membership from all federal agencies involved in aquaculture regulation and science. The Director of the Office of Aquaculture represents the Secretary of Commerce on the IWG-A and serves as co-chair and member of the Executive Committee of the IWG-A. A staff member of the National Sea Grant College Program Office also serves on the Executive Committee.

2a. NOAA Fisheries (NMFS)

The Office of Aquaculture is part of NMFS and is managed from NMFS Headquarters in Silver Spring, Maryland. NMFS focuses on regulatory, technical, and scientific services required for federal development and management of marine aquaculture within the context of NOAA's marine stewardship missions. The Headquarters Office provides strategic direction for NMFS's Aquaculture Program, manages budgets, coordinates science and outreach activities, addresses regulatory issues, conducts grants review and management, coordinates international activities, and serves in a liaison role with other offices, federal agencies, and the public.

NMFS has five regional aquaculture coordinators in each NMFS Regional Office other than Alaska. Regional coordinators focus on regulatory and permitting activities in federal and state waters, serve as liaisons with stakeholders and federal, state, local, and tribal governments, assist with grants management, and foster science collaborations. Regional Coordinators report to Regional Administrators, but closely coordinate their activities with the Headquarters Office of Aquaculture.

NMFS also conducts the majority of NOAA's in-house aquaculture research, with activities at the Northeast Fisheries Science Center in Milford, CT; Northwest Fisheries Science Center in Seattle, WA (Manchester and Montlake); and an emerging program at the Southwest Fisheries Science Center in La Jolla, CA. Additional researchers at other Science Centers (Pacific Islands, Southeast, and Alaska) also work on aquaculture projects. Research efforts focus on designing and refining scientific "tools for rules" to inform permitting decisions, evaluating the ecosystem services of marine aquaculture, understanding changing ocean conditions, and developing and refining aquaculture technologies. The Milford Laboratory has historically focused primarily on shellfish aquaculture with some work on finfish and changing ocean conditions. The Manchester Laboratory has focused on finfish aquaculture and technology development, but shellfish capabilities have recently been reestablished with the opening of the Kenneth Chew Shellfish Research and Restoration Hatchery.

In FY 2015, Congress appropriated \$5.7 million to an aquaculture-specific budget line, which is managed by the Headquarters Office of Aquaculture. While allocation of funding varies by year, typically half of these funds is allocated to headquarters and regional coordinators (staff time). The remaining half is put towards internal science center and regional projects. Funding determinations are made through an internal competition, as budgets allow. In addition to the aquaculture budget line, three primary budget lines (and several other smaller lines) are utilized for NMFS Science Activities (Appendix 2).

NMFS also provides extramural funding to support industry development through the Saltonstall-Kennedy and Small Business Innovation Research Programs and the Marine Fisheries Initiative (MARFIN). The amount of funding provided for aquaculture projects in a given year depends on a number of factors including the number and quality of proposals received and the availability of funding.

In practice, the headquarters Office of Aquaculture coordinates and leads the broader NOAA Aquaculture Program. Other components of the NOAA program are listed below.

NOAA Fisheries

Role of Headquarters Office:

- Drive strategy and lead a coordinated Aquaculture Program
- Build internal support for the Aquaculture Program
- Provide guidance to regional decision-makers to improve consistency in permitting
- Support regions in designing and implementing regulations for aquaculture in state/federal waters
- Coordinate science activities and drive science strategy
- Coordinate program's outreach activities
- Budget planning and execution
- Coordinate international science and policy activities
- Assist with grants management

Role of Regional Coordinators:

- Work with partners to improve permitting processes in federal and state waters
- Facilitate communications with stakeholders and federal, state, local, and tribal governments
- Assist with grants management
- Communicate the best available scientific information to managers, decision-makers, and stakeholders on the benefits, impacts, and management of marine aquaculture
- Foster communication between scientists and managers to identify and evaluate research and information needs to advance the marine aquaculture sector

2b. OAR National Sea Grant College Program

The National Sea Grant College Program housed within OAR integrates aquaculture research, extension, and education through the national office and 33 state Sea Grant university programs across the U.S. coasts and Great Lakes. Sea Grant manages NOAA's primary extramural grant competition for aquaculture applied research, technology transfer, and extension. These grants support activities by universities, industry, and nongovernmental organizations. Sea Grant extension agents live and work in coastal communities, providing science-based information to local governments and citizen groups, and transferring technologies to industry. About 25 to 30 extension professionals spend at least part of their time working on aquaculture extension. In FY 2015, the National Sea Grant College Program received a \$4.5 million appropriation for its Marine Aquaculture Program. In addition, state Sea Grant programs typically contribute additional federal Sea Grant funds toward aquaculture projects (approximately \$2 million per year). The federal funds leverage additional state and private funding.

2c. NOS National Centers for Coastal Ocean Science

The National Centers for Coastal Ocean Science (NCCOS) conduct aquaculture research primarily at the Beaufort, NC and Charleston, SC laboratories. The Coastal Aquaculture Planning and Environmental Science (CAPES) program in Beaufort aims to provide tools and services for coastal managers to maintain healthy ecosystems while supporting aquaculture development within the coastal zone

2d. Other Affiliated NOAA Programs

Other programs also contribute to the NOAA Fisheries' aquaculture mission:

- The NMFS Seafood Inspection Program (SIP) provides services to the aquaculture industry such as sanitation inspections, system and process audits, product inspection and grading, and export certifications. In addition, the SIP advises the agency on aquatic animal health issues in close coordination with the Office of Aquaculture, NMFS science centers, and the National Seafood Inspection Laboratory. The SIP and the Office of Aquaculture provide agency representation to the interagency National Aquatic Animal Health Task Force.
- The National Seafood Inspection Laboratory (NSIL) in Pascagoula, Mississippi, and the Northwest Fisheries Science Center conduct laboratory analyses on seafood quality and pathogens and toxic chemicals that may affect seafood. NSIL represents NOAA at meetings of the Interstate Shellfish Sanitation Conference.
- The Sustainable Fisheries Program issues permits for aquaculture in federal waters under MSA, including ensuring compliance with NEPA and other federal regulatory requirements.
- The Office of Habitat Conservation (OHC) works closely with the Office of Aquaculture as a key partner in the implementation of the National Shellfish Initiative. OHC provides technical and regulatory expertise on the interactions between aquaculture and Essential Fish Habitat (EFH). Habitat Divisions within NMFS regional offices review federal permit applications for aquaculture to ensure compliance with the EFH provisions of the MSA. OHC also works on restoring native bivalve shellfish populations as one of four priority habitat restoration approaches to rebuilding fisheries, recovering protected resources, and improving the resiliency of coastal communities. This work includes the use of shellfish aquaculture as a tool for shellfish restoration.
- The Protected Resources Program reviews federal permit applications for aquaculture to ensure compliance with the MMPA and the ESA. Under ESA, the Program can also use controlled propagation of a listed species (aquaculture) as a tool when recommended in an approved recovery plan or when determined to be necessary to prevent extinction of a species (e.g. abalone, Atlantic salmon, several species of Pacific salmon, and corals).
- The NOAA Ocean Acidification Program helps to further scientific understanding and predict changes in the Earth's environment as a consequence of continued acidification of the oceans and Great Lakes. Aquaculture is utilized as a tool to conduct research projects and the marine aquaculture sector also is an end user of this research.
- Additional NOS Programs including the Integrated Ocean Observing System (IOOS), Harmful Algal Bloom Operational Forecast System, provide essential data and services to ensure proper ecological and human health management of the aquaculture sector.

Appendix 2 - NOAA Aquaculture Funding History

Table A1: Total NMFS Aquaculture Funding (Thousands of Dollars)

Organization	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY2014
NMFS HQ (e.g., management, outreach)	\$2,361	\$1,736	\$1,705	\$1,953	\$1,360	\$1,569	\$1,406	\$1,433
Regional Coordinators	\$135	\$132	\$229	\$428	\$589	\$906	\$873	\$908
Northeast Fisheries Science Center	\$3,132	\$3,758	\$4,200	\$4,850	\$4,802	\$4,176	\$4,320	\$3,430
Northwest Fisheries Science Center	\$1,838	\$2,248	\$2,591	\$3,457	\$3,187	\$3,092	\$2,636	\$2,687
Other Fisheries Science Centers	\$335	\$0	\$54	\$161	\$726	\$239	\$205	\$144
Transfers to OAR and NOS	\$19	\$733	\$494	\$433	\$282	\$475	\$296	\$257
Total	\$7,820	\$8,607	\$9,273	\$11,282	\$10,946	\$10,457	\$9,736	\$8,859

Table A2: Extramural Funding for Aquaculture Under Saltonstall-Kennedy Grants Program

	FY 2007 *	FY 2008**	FY2009	FY 2010	FY 2011*	FY 2012*	FY 2013	FY 2014***
# of aquaculture projects funded		1	19	8	-	-	6	16
Total funding for aquaculture projects	-	\$69,791	\$4,202,438	\$1,471,129	-	-	\$1,561,297	\$4,763,458
Total S-K grant competition	-	\$2,613,479	\$8,605,617	\$4,835,204	-	-	\$10,511,660	\$25,000,000
% funding to aquaculture projects	-	3%	49%	30%	-	-	15%	19%

*There was no S-K grant competition in FY 2007, 2011, 2012, **Aquaculture was not a funding priority in FY 2008 *** Numbers preliminary based on projects selected for funding.

Table A3: Extramural Funding for Aquaculture Under NOAA/Department of Commerce SBIR Program

	FY 2007	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
# of aquaculture projects funded	3	3	3	4	2	1	2
SBIR Phase 1 funding	\$187,895	\$94,651	\$180,975	\$376,998	-	\$95,000	\$95,000
SBIR Phase 2 funding	\$300,000	\$559,000	\$299,998	-	\$598,427	-	\$397,510
Total aquaculture project funding	\$487,895	\$653,651	\$480,973	\$376,998	\$598,427	\$95,000	\$492,510

Table A4: Extramural Funding for Aquaculture under OAR National Sea Grant College Program*

	FY2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013
# of aquaculture projects funded	23	11	36	33	40	47
Total aquaculture project funding	\$4,806,000	\$1,693,000	\$4,733,000	\$4,315,000	\$4,381,000	\$4,348,000

* Table includes core funding



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